1003-7 Primary Pulmonary Hypertension: Invasive and Noninvasive Monitoring in Patients Receiving Continuous Intravenous Flolan Infusion

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Patients (Pts) with primary pulmonary hypertension (PPH) pose a difficult management problem. There are few effective therapies and hemodynamic monitoring is needed to document response. Flolan, a prostaclyin, is being used as a long term continuous infusion in patients with documented PPH. The purpose of the study was to use Doppler-Echocardiography (Echo) to monitor pts receiving Flolan. We used Echo to measure the maximum systolic pressure gradient between the right ventricle and atrium (ΔP) and cardiac output (CO) and compared them to right heart catheterization (Cath) in 30 patients with PPH. 19 of these pts went on to receive Flolan for more than one month and were followed with serial Echo studies to monitor hemodynamic response. *Methods:* Invasive right heart measurements and thermodilution CO were performed during the initial evaluation and followed rapidly by Echo. Tricuspid regurgitant velocities, aortic flow and aortic root area were performed at the initiation of therapy and at follow-up visits. Care was taken to align the regurgitant jets with the Doppler transducer to maximize velocity measurements. The echocardiographer was blinded to the Cath data. The formula $\Delta P = 4V^2$ was used where V is the tricuspid regurgitant velocity. The CO was obtained using the velocity time integral for aortic flow $\times$ the aortic area $\times$ HR. *Results:* The correlation between Echo and Cath data for ΔP and CO were good with $r = 0.91$ and 0.89 ($p < 0.001$) respectively. The average noninvasive follow-up period for the 19 patients receiving Flolan was 7.3 months with a range of 1–15. The mean ΔP before treatment was 94 mmHG demonstrating the severity of the PPH. After treatment, 52% (10/19) pts had a decrease in the ΔP of 31–55%. An additional 26% (5/19) had a drop in ΔP of 4–19%. CO increased in 63% of the pts. *Conclusion:* Echo measurements correlate well with Cath measurements in PPH pts. Pts receiving continuous infusions of Flolan for treatment of PPH experience a decrease in ΔP which can be monitored noninvasively using Echo. The persistence of this decline in ΔP and its relationship to clinical outcome needs further study.

1004 Intravascular/Intracardiac Ultrasound

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Ernest N. Morial Convention Center, Hall E
Presentation Hour: 1:00 p.m.–2:00 p.m.

1004-54 Correlation of Intravascular Ultrasound Imaging with Histology of Normal and Diseased Pulmonary Arteries

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Intravascular ultrasound (IVUS) imaging of pulmonary arteries may provide useful clinical information to assess the degree of vascular disease. To investigate the feasibility of IVUS to identify the morphological changes associated with pulmonary vascular disease, 21 arterial segments (diameter range 2–6 mm) were obtained at autopsy and formalin fixed. IVUS imaging was performed with a 25 MHz mechanical catheter. Elastin and trichrome stains were used to grade the collagen and elastin content. IVUS and histology (Hist) images were digitized and measured. An intensity index was used to quantitate the IVUS appearance based on the average intensity per pixel and the standard deviation of intensities.

Results: Based on the histologic appearance, the arterial segments were categorized into normal (n = 6), mild hyperplasia (n = 9), and moderate hyperplasia (n = 6). Although the lumen size was easily identified, IVUS imaging revealed only a single layer appearance despite the presence of intimal hyperplasia. In distinction to coronary and peripheral arteries, IVUS did not identify a 2 or 3 layer appearance in the pulmonary arteries. This homogeneous IVUS pattern was due to the high elastin or collagen content of the intima, media and adventitia.

	HIST	IVUS	r	p
Lumen Perimeter	9.3 ± 2.8	10.4 ± 3.4	0.96	<0.0001
Lumen Area	7.5 ± 5.0	5 ± 6.7	0.97	<0.0001

	NL (n = 6)	Mild (n = 9)	Mod (n = 6)	P (ANOVA)
Intensity Index	0.58 ± 0.08	0.65 ± 0.11	0.76 ± 0.05	<0.01

Conclusion: IVUS accurately measures the lumen size of pulmonary arteries. It is unable to identify the degree of intimal hyperplasia because of the homogenous echogenicity across the different layers of the artery. The echo intensity index may be useful in distinguishing normal from diseased pulmonary arteries.

1004-55 The Utility of a New Integrated High Resolution Intracardiac Ultrasound/Ablation System in a Canine Model

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To examine the utility of ultrasound visualization for guiding ablation of cardiac tissue, an intracardiac ultrasound cardioscope incorporating a catheter visualization/delivery system into the imaging head of the device was examined in 16 dogs. The ultrasound ablation probe (Acuson 7.5 MHz/8 mm) was introduced via the right external jugular vein into the right atrium/ventricle. Long axis imaging from the probe to a depth exceeding 7 cm enabled high resolution visualization extending from the pulmonary veins, through the level of each cardiac valve to the left ventricular apex. Ablation catheters along with tip electrodes were readily visualized, allowing their non-fluoroscopic passage across the aortic, mitral, and tricuspid valves for ventricular mapping and ablation. Specific parallel or perpendicular catheter tip/tissue orientation was readily documented in each case, as was the catheter tip/tissue contact with the use of standard and basket array catheters. For ablation of right heart structures, an ablation catheter port incorporated into the imaging head facilitated direct visualization of the catheter-tissue interface and evolving tissue injury and thrombus formation during ablation. Using non-contrast techniques, ablation lesions in the left ventricle could be measured and catheter-related clot formation monitored. Perfusion catheter tip flow used to ameliorate the ablation-related impedance rise was also documented by color flow techniques. These studies demonstrate the facilitation of ablation catheter positioning and catheter tip/tissue orientation and contact monitoring with a high resolution intracardiac ultrasound system. This study strongly supports the concept of incorporating ultrasound and ablation catheter deployment into a single cardioscopy system.

1004-56 Ultrasonic Monitoring of Fat Embolization During Major Orthopedic Procedures: Experimental Studies in Sheep Define a New Utility for Intracardiac Ultrasound

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Fat embolism syndrome (FES) has been described following bone injuries of the lower extremities and intramedullary fixation procedures, such as hip replacement and can have serious pulmonary vascular consequences. We performed an intravascular ultrasound (IVUS) study to directly visualize and quantitate the release of marrow contents following femoral fracture and reamed or non reamed intramedullary fixation. One or more portions of these orthopedic maneuvers were performed in 30 anesthetized and ventilated sheep, including femoral fracture (F), opening the intramedullary canal (OC), reaming (R)(reamer sized 8, 8.5, 9, 9.5, 10.5, 11 mm in diameter) and nail insertion (N). Thirty sheep were randomized into 3 groups (n = 10): Group 1 (G1) had F, OC, R and N. Group 2 (G2) had F, OC and N but no reaming. Group 3 (G3) had F only. A high resolution 8 French, 15 MHz IVUS catheter (Aloka Co. Ltd.) was placed via the jugular vein to the junction of the inferior vena cava and right atrium (RA). Echogenic embolic particles (EP) visualized entering the RA following each maneuver were quantified by counting the maximal number of EP/video frame, measuring the maximal size of EP and the duration of EP appearance. Small numbers of small particle embolic events were denoted on F alone, but opening through to the canal as the first maneuver in sequence followed by N, produced the largest EP's and the longest duration of showers of emboli in G1 and G2 ($p < 0.01$). F and all the other procedures involved in intramedullary fixation constantly induced release of marrow contents into the circulation detectable by ultrasound. As other correlates to these observations, a transient increase of pulmonary vascular resistance by mean of 1.3 resistance units was noted in the animals in G1 and more widespread microscopic findings of embolic events were found in G1 and G2 than in G3 at post-mortem lung examination. Our findings may help to explain the mechanism of FES following femoral fracture and intramedullary fixation. The use of IVUS for monitoring EP showers may aid refinement of orthopedic surgical procedures.